

December 11, 1849.

JOSHUA FIELD, President, in the Chair.

No. 818.—“On the facilities for a Ship Canal communication between the Atlantic and Pacific Oceans, through the Isthmus of Panamá.” By Lieut.-Colonel John Augustus Lloyd, Assoc. Inst. C. E.*

FROM the various notices on this interesting subject in the “*Journal des Débats*” and other papers, it appears that very erroneous opinions are still entertained, as to the real nature of the facilities which are so abundantly available, towards effecting the construction of a canal across the Isthmus of Panamá. Nature has bestowed so many advantages towards this communication, and even concentrated them so nearly at one point, that it will be a matter of wonder, in after ages, why so many generations should have neglected to use them. So little, however, are they known, or so much are they underrated, that if those who have had an opportunity of exploring the country do not attempt to combat these erroneous notions, the accomplishment of a work of vast importance will be postponed to a yet remote period. If, in this nineteenth century, a canal communication, of such trifling extent, had been required through any portion of England, it would have been long since undertaken, and completed, by a few private individuals, or interested landed proprietors.

The advantages of the port of Panamá, the value of the coast in its vicinity as far as Chorrera, and the importance of the unusually great rise and fall of the tides there, seem to be entirely overlooked; indeed, the writer in “*Blackwood’s Magazine*” is evidently so far biassed in favour of the railway communication, that he passes over, very lightly, all the superior advantages of a canal communication, from the Atlantic, into a smooth and tranquil ocean. But, previous to making a few remarks on the railway communications, it is necessary to notice briefly some of the paragraphs in the papers already alluded to.

In reviewing the operations in the Isthmus of Darien, the “*Journal des Débats*” states, “that the survey of Messrs. Lloyd and Falmarc was not by any means complete.” It must be re-

* The discussion upon this Paper extended over a portion of three evenings, but an abstract of the whole is given consecutively.

marked, that the lines of level taken by Colonel Falmarc and the Author, were commenced chiefly with a view of ascertaining the difference of level between the two seas. If the writer in the "*Journal des Débats*" had been aware of the interminable and vexatious difficulties, that the officers of engineers employed by General Bolivar had to encounter, in a country governed by a fierce and jealous Biscayan (General Sarda), who was personally hostile to the "*Libertador*," and consequently to them; if he had witnessed the miseries and privations which these officers had to bear up against, refused all pecuniary assistance, suffering from political enmity, and purposely exposed, through the Commandant General's wily machinations, to the murderous attacks of the brigands then infesting the Isthmus, and who had already set the governor at defiance, he would have been disposed to view more charitably the exertions of Messrs. Lloyd and Falmarc. Topographical researches in a civilized country, or levelling along the banks of a canal, are very pleasant things; but to carry on such operations while exposed as a target for "*Cisneros*" and the carabines of his band of brigands, is a widely different matter. It is, however, satisfactory to record, that since that period the French, Spanish, German, American, and English engineers, who, under less disadvantages, have visited the Isthmus, all agree that the operations of Lloyd and Falmarc are entitled to confidence.

The line of levels was taken, as much as possible, along a beaten track, to avoid cutting through the dense forests: this will account for the height of the summit level, which was far above that of the country generally, between the two seas. Throughout South America, from time immemorial, the first explorers, in pushing forward their discoveries, sought some neighbouring eminence, from which to reconnoitre and lay out a track, that has been preserved in after ages, and has become the "*camino real*;" the consequence is, that even across the great Andes, the tracks are generally along, or over, the summits of the chain. M. Morel, one of the French engineers, states that 12 metres is the highest point, in one direction, across the Isthmus of Panamá; although this statement may perhaps never be verified, still it appears certain, that the ground on the eastern banks of the Trinidad will be found so comparatively low, as to offer a very favourable line for a ship canal.

In a recent number of "*Blackwood's Magazine*" there occur the following passages:—"The harbour, or rather roadstead, of Panamá is formed by a cluster of islands, lying about six miles

from the shore, under the shelter of which vessels find safe anchorage. . . . The obstacles above enumerated, at once convinced the writer, that a ship canal in this direction was impracticable.

. . . In the pursuit of this object Mr Lloyd seems altogether to set aside the idea of a canal. . . . Having made up his mind that a railroad is best adapted to the locality, he proceeds to trace two lines."

In the present stage of engineering science, there are no serious obstacles, excepting the climate and the expense, to prevent a canal being cut from one sea to the other, of sufficient width and depth, to float the largest ship in Her Majesty's Navy. The fact of two lines of railway being laid down on the Author's map of the Isthmus,* was rather to point out the most favourable direction for such a work, as he believes that a rough country railway should be the pioneer to, or, at least, be carried on conjointly with, a canal—thus affording the means of rendering available the vast and wonderful resources of the country itself, in timber, stone, and other materials.

It must be remembered, that the rise and fall of the tides at Playa Prieta, close to Panamá, average from 20 feet, at full and change, to about 27 feet. Now this one fact gives immense advantages to the engineer, for by it almost all other difficulties, in coast-water communication, can be overcome. The Bay of Panamá, it is true, is an open roadstead; but it is equally true, that there is sufficient water, at any time of the tide, and within a short distance of the shore, for the largest ships; and the rare occurrence of heavy gales, or rolling seas, render such a roadstead comparatively as safe as a land-locked harbour, in other parts of the world; and even in case of bad weather, there is excellent anchorage, and secure shelter, at the Island of Taboga, distant about seven miles, where ships can also take in provisions and water.

It is admitted, that at low water, excepting in the tortuous channel of the Rio Grande, the coast immediately adjacent to Panamá is high and dry for some distance seaward. There are, however, in various parts of the bay, and close to the shore, large and well-known holes in the "laja," or rock, or, as they are called in Panamá, "huecos," in which vessels of considerable burthen can ride securely at anchor, independent of the surrounding flat; and it is often possible to walk from the shore, to within a short distance of a vessel in such a position. With this peculiar advantage, the tranquil sea, and the great rise and fall of the tides, it is

* *Vide* Phil. Trans. for 1830, page 60, *et seq.*

hardly necessary to point out to the engineer, that the greatest facility is given for working tide-work ; a ship canal of any dimensions, with sufficient water for loaded vessels, could be cut through the soft rock, close up to the shore of the city of Panamá, or Chorrera, where every advantage is, by the same means, available, for the construction of basins, and wet and dry docks ; whilst the flat surface of the soft rock, in the immediate vicinity, offers the ready and economical means of building a sea wall if necessary.

No one can question the advantages which a ship canal would afford to the whole world ; whereas those offered by a railway are extremely limited, and there are even many positive objections against such a means of conveyance in that country.

A railway would be unceasingly exposed to much damage and accident, from the great humidity of the climate, causing "greasy rails," and from the frequent heavy rains, which would also involve a heavy outlay, for precautions and supplementary works, to guard against floods. The cost of working such a line would be enormous, as it would be requisite to have a large establishment of highly-paid superintendents, European engineers and artificers, and to have workshops erected and maintained, in a climate unfavourable to Europeans ; whilst great inconvenience, as well as expense, would be occasioned by frequent changes, and new appointments, consequent upon the invaliding of the different officials. Assuming, however, that even these difficulties could be successfully combated, and the railway to be in full play, there would yet remain others which could not be overcome. For instance, a ship laden from Europe, on arriving, would anchor in, or near, the bay of Chagres ; its cargo, of dry goods, silks, cloths, and machinery, or the more fragile ventures of glass, furniture, cutlery, &c., would then have to be discharged into boats, on a tempestuous coast, in a humid atmosphere, and in a climate subject to torrents of incessant rain, as heavy as those on the African coast ; and though every package might be separately secured, and enclosed in wax cloth, as is the invariable and expensive custom, for goods destined for the interior, still, it is more than likely, that their frequent shifting and removal would cause great damage ; for the goods must continue their route, first by river, then by railroad, be again placed in boats, and, finally, be once more conveyed on ship-board. Now, without estimating the extra expense of this plan, it is certain, that some particular descriptions of goods would never reach their destination, in a fit state for the market. The unladen ships would have, in the mean time, to remain at anchor on the coast, and the crews would be exposed, at all events on the Chagres side, to a pes-

tilential climate, which is peculiarly destructive to European constitutions.

On the other hand, on a ship canal, if it can be accomplished, and there is nothing but the rooted prejudices of ages to prevent it, the goods would be secure, and under shelter, during their transit; whilst the voyage would be of such short duration, that the health of the crews would not be injuriously exposed, and the masters of vessels would have the power of proceeding to a healthy station in the Pacific, to provision and water, in safety and comfort. The labour, delay, and expense of hoisting a cargo in and out of the vessels, with the consequent damage and risk of pilfering, would thus be altogether avoided.

The construction of a ship canal would be the most easy, the most economical, and the most efficient plan; and it might be so arranged, that as it advanced, and the deepened channel was made, a railroad of wood, constructed of "gualacan," or guyacum, (a kind of *lignum-vitæ*.) should be laid down by its side. Whatever the summit level may be, an ample supply of water is certainly available, for hardly a mile occurs, throughout the whole transit, where there do not exist rivulets and "quebradas," furnishing a body of water fully sufficient, for the lock expenditure, for any number of vessels.

It seems obvious, that the starting point should be at the beautiful bay of Limon, thence by a short canal of two miles and a-half in length, through a perfectly flat country, to the river Chagres, then along it and the river Trinidad, as far as the depth and bearing of the latter would suit the line of transit. The river Chagres, to the junction of the Trinidad, is in every respect suitable, having, with the exception of one small rock, about 6 feet under water, a uniform depth of from 20 feet to 28 feet, with steep banks and deep water, close to the edge. By this arrangement the officers, workmen, and property, with the necessary machinery and tools obtained from Europe, could be at once brought to the place of operation, at the smallest expense; and the subordinate officers and engineers, might be lodged at such a distance from Chagres, as would give them the best chance of retaining their health.

The materials, not only for the railway, but for the entire work, may be found in the vicinity; and "gualacan" trees, of immense diameter, are so plentiful in a forest on an eminence near Gatun, which is a few miles to the south of the bay of Limon, that almost the whole of the timber required, even for so great an undertaking, might be brought from that one spot.

The ultimate success of such a work, would depend much on the

description of men who were employed. In the 'Bengal Hurkaru,' it is proposed, that Great Britain, France, and America should each contribute a certain number of convicts; but such a concentration of vice would be highly objectionable, though it could not be urged against the employment of two classes of convicts, from countries under the same dominion.

The deportation of felons from this country to the Isthmus of Darien, while helping to relieve the embarrassments of the Home Government, in regard to the satisfactory location of criminals, would render their labour available, towards the completion of one of the greatest, and most useful projects, ever yet attempted; at the same time, the opportunities for reclaiming those in whom any shadow of morality yet remained, would be as abundant, and at least as available, as in the larger penal stations.

The narrow neck of land forming this portion of the Isthmus, although communicating with two vast continents, would be almost as secure as a prison-house, only requiring a small portion of the coasts to be guarded. To the south, the isolated hills and the small range of mountains are inhabited by the Mandingo Indians, a fierce and jealous race, with whom a runaway convict would find no shelter. The lower lands and savannahs are also, to a certain extent, in their possession; while further south-west, and extending towards Point Guarapachin and the river Choco, the whole country is guarded by the powerful and warlike race of Bayamon Indians, who the Spaniards admit were never conquered; they hate even the name of a Spaniard; but it is certain that it would be easy for the English to enter into a friendly treaty with them, to arrest all convicts attempting to pass through their territory; the only difficulty would be so to control their zeal, that they should bring a living prisoner, instead of merely his head. To the north, an efficient barrier would also be found in the mountainous district and table lands of Veragua, which are more thickly populated than those of the other side; and the eastern coast would be safely guarded by the Mosquito Indians. There would, consequently, be as much difficulty of escape as in New South Wales, and certainly less chance of mischief to a community, if any attempt was successful.

The next class in the scale of utility, as excavators or 'navvies' in the Isthmus, would be convicts from Bengal, or the other presidencies. The similarity of the temperature and climate of the Isthmus to their own, and their power of enduring fatigue under a tropical sun and during rains, would render them well suited as labourers for such a work. The most common and economical articles of food, such as rice, salt fish, ghee, or mantégua, and to-

bacco, are exactly those to which they have been most accustomed in their own country ; moreover, the general habits of these men, their language, and their religion, would tend so to isolate them from the natives, or the European convicts, that they would, in most cases, be deterred from attempting to desert, and, under proper discipline, they would be easily kept in order, and would be found hard-working and intelligent men.

Fatigue parties, under military discipline, might be obtained from Africa, or from the surplus black population of the West Indies, and a very powerful resource might be counted on in the Isthmus itself. The creole natives are a hardy race, in most cases willing and intelligent ; their wants are few, and their simple habits peculiarly fit them for the description of labour that would be required of them. The pay of a strong able "peon" in the country is about a real, or a real and a half, (which is equal to sixpence, or ninepence,) per day, and their rations, consisting of a pint of rice, one pound of "tassajo" (dried beef in strips), and a "golpe" of "aguardiente."

There are, however, other, and still more powerful resources, which, while being made available for carrying out the great work, would produce the most important advantages to Great Britain and Ireland, through a different channel. The new country, properly used, would become a spot for emigration and a rich territory, for tens of thousands who can now barely manage to scrape together a poor subsistence at home.

It is the present fashion to relieve the pressure of the surplus population, by emigration to the Canadas, to the United States, and to the arid plains of Australia. To the poor, but industrious and honest mechanic, or labourer, the rich lands of Canada are no longer within reach, without pushing his weary journey so far west, that his limited means are often prematurely exhausted, leaving him a worn-out and wretched pauper, far from his own land, or friends, and in a climate still more rigid than his own. In the United States a poor man finds no home, but task-masters as anxious to obtain their existence as himself ; while the insalubrity of the great and pestilential rivers in the far interior becomes, to the wanderer, a source of wretchedness and misery, which too often only ends with his life. Australia, with its trackless wastes, holds out few temptations to the expatriated settler ; it may be a happy goal for a few, but besides the length and expense of the voyage, there is such an ordeal of privation and misery to pass through, that many, after their arrival on *terra firma*, have been found to shrink from encountering it.

The Isthmus of Darien has none of these disadvantages; it is comparatively within an easy distance, and the emigrant's destination is reached almost on landing; its resources are immense, and its fertility the most rapid and wonderful. It possesses the finest waters, the most varied, abundant, and precious forests in the world, an inexhaustible supply of building materials of all kinds—limestone, firestone, sand, and metals; whilst food, consisting of fish, birds and cattle, rice, maize, and fruit, is equally abundant and cheap. The country is extensive, and the present population greatly disproportionate to its superficial area.

It is not consistent with the limits of this Paper, to offer proof, in detail, of what is here advanced, but, if necessary, it can readily be produced.

In the rapid accomplishment of a work, in which all Europe is so much interested, no means could be so prompt, so certain, and so efficient as emigration; and even the vaunted, but ephemeral, riches of the new "El Dorado," California, could not so surely, and scarcely more quickly, repay both labour and capital, than the occupation of the Isthmus of Darien, by an intelligent and industrious race, provided with a water communication between the two great oceans. Such would be the individual advantages to the settler; but the occupation of the Isthmus, by a hardy and industrious race of Britons, would produce beneficial results in a political point of view.

Nature seems to have marked, by its physical features, a boundary in the Isthmus of Darien, which, though it may appear insignificant, can, if peopled from Great Britain, present a human barrier of such formidable power, as to limit, if not completely hold in check, any attempts of the Government of the United States, towards aggrandizement and increase of territory. The Texas, California, and Mexico are all incorporated with the "stars and stripes," and the inhabitants of Guatemala, Nicaragua, &c., if they even have the will, can present but a feeble front against such great power; and it is more than probable, that the Americans will never be satisfied, until some part, at least, of the other continent, bows to the same ensign.

The climate of the Isthmus may be raised as an objection, against its being a fit field for emigration. It is not attempted to be denied, that the town of Chagres, and the now useless city of Portobelo, are unhealthy; but it is more from their extraordinary and unfavourable position, than the climate, and they are points where the settler needs no residence. In the forests, and in the interior generally, although there is much rain, the temperature is by no

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means high, in comparison with other intertropical stations; and from an experience of both, the Author can confidently state, that the country is generally more healthy than any of the West Indian islands and colonies. One good proof is, that the Author and his companions passed nearly two years in the forests, the greater part of the time in sheds, or huts constructed by themselves, from day to day, or week to week, with indifferent living and always barefooted, yet they never suffered. He has known many persons, who have lived there for years, return from thence well; and several English ladies, one a member of his own family, resided for four years in Panamá, without any detriment to their health.

The only doubt which now remains to be answered is, whether there will be any, and what, difficulties in obtaining a cession of territory.

That the English have once had a footing in the Isthmus of Darien, there is no question, although it was certainly at some distance from the proposed line of communication. So long back as 1695, there was formed at Edinburgh, under the auspices of several Scotch noblemen, a chartered company, bearing the title of "The Scotch Darien Company." A large expedition was fitted out in 1698, and many respectable Scotch families embarked with their capital, and sailed for the Darien, where they founded and erected a colony (the remains of which are even now reported to exist) at a favourable point, on the north-west shore, in about $9^{\circ} 30'$ N. latitude, and $77^{\circ} 36'$ longitude. It is said, that the settlement bade fair to be a most thriving one; rich pastures and buildings were rising on every side, when the jealousy of the old viceroy and the Spanish Government was excited, and, on their referring to the British Court, no countenance was given by the latter to the infant colony, so that an expedition was ordered against it, and in 1700 its inhabitants were ejected, a great many of them being cruelly murdered, and the remainder dispersed.* There can be little doubt, that a regular grant from the Spanish authorities had been made, but as the settlers had no protection from their own Government, they gave way to a tyrannical and cruel power.

About twenty years back, the Commandant-General, with the knowledge of the Government of Panamá, made a tangible offer of

* The Author read at Carthagena some accounts of this colony, and he thinks that the proofs of its existence, and of its right to the ground, might be found in Edinburgh.—(*Vide* the first letter from the Council of New Caledonia, New Edinburgh, 1698.)

a portion of the Isthmus to the British Government, through its consul, proposing, at the same time, that a large body of native troops should be employed, under severe discipline, and in rotation, for the opening of a communication. It is most certain, that the whole continent is heavily indebted to this country, from the immense and frequent loans made to the then great republic, since divided into several states. Of this the "Istmo" should bear its share, although the ability to pay may be very questionable. It is suggested, therefore, that with such a debt, and a little honesty, a large incumbrance might be got rid of, by their granting a tract of land to the British, which would gladden, by a prospect of remuneration, many a heart that has long been hopeless.

In conclusion, the enterprising government, or company who would come forward to protect and perfect this project, would reap golden returns, and have the honour of conferring a benefit to the world, as brilliant and as extensive as any ever contemplated by human mind.

The Author has attached to this Paper, a copy of the commission given to him by his dear and respected old master, General Bolivar, who, after repeated solicitations, instructed him to proceed to the Isthmus, for the object which he had the good fortune to accomplish: this document will show, that it was an Englishman who was first entrusted with a work, which so many have since examined, and in some degree appropriated, without acknowledgment.

APPENDIX.

Copy of His Excellency the Libertador's Commission to Captains Falmarc and Lloyd, for the examination of the Isthmus of Panamá.

REPUBLICA DE COLOMBIA.

*Estado Mayor de Cundinamarca,
Seccion 4ª Parti-pasiva.*

*Quartel General en Bogotá,
á 29 de Noviembre de 1827=17.*

Al Capitan de Ingenieros Juan Augustin Lloyd.

El Señor Jefe del Estado Mayor General, con fecha de ayer, me dice lo siguiente :—

“ El Señor secretario de la guerra, con fecha 26 del actual me dice lo siguiente :—

“ S. E. el Libertador Presidente ha tenido a bien comisionar á los Capitanes de Ingenieros Mauricio Falmarc, comandante accidental del cuerpo en el departamento del Istmo y Juan Augustin Lloyd para que reconociendo la provincia del Darien del sur (cuyoplano acompaño para que V. S. se lo haya parar) informen facultativamente sobre las facilidades ó dificultades que hubiere en dicha provincia, para dar comunicacion á los dos marcs. Si esto fuese practicable la delinearan y previo un prolixo examen del terreno, formarán el plano y el presu puesto aproximado del costo. La comiçion se estiende tambien a que se reconocen el departamento del Istmo, el punto o puntos por donde se crea (segun informen de personas inteligentes o practicas) que puede abrirse camino o canal, y al efecto formarán el plano e presu puesto correspondientes. La intendencia y comandante-general del departamente expresado auxiliaran eficazmente á los comisionados, é instruiran al gobierno de si estos se han dedicado ó nó al cumplimiento de su comision y si la continuan con eficacia á este fin se les dira lo concerniente por la secretaria de mi cargo.

“ El primero de la comision es el Capitan Falmarc, y el segundo el Capitan Lloyd, Estos oficiales seran auxiliados con bagajes, barquetas, prácticos y demas que sea necesaria, y S. E. quiere que V. S. les encarque que el gobierno espera que en la comision que se les confia, procederan con toda independencia sin dejarse influir de intereses de localidad, y seguros de que en todo tiempo seran responsable al gobierno, que les prohíbe de escribir nada que no hayan visto ni reconocido.”

Lo comunico a V. S. para que se sirá hacerle al Capitan Lloyd, que se halla en esta capital, para que marche inmediatamente á dar cumplimiento á la indicada comiçion, advirtiéndole que el plano de que trata esta orden se para av con esta fecha al E. M. del Istmo para que se en tregue al Capitan Falmarc.

Todoloque comunico á V. para su inteligencia y cumplimiento, debiendo vd. pasar desde luego al Estado Mayor, para el correspondiente pasaporte.

Deos guardé á V.

(Signo)

RAMON GUERRA,
Estado Mayor.

(Translation.)

REPUBLIC OF COLOMBIA.

*Estado Mayor of Cundinamarca,**Head Quarters, Bogota,*

Section 4.

29 November, 1827 = 17.

To the Captain of Engineers, John Augustus Lloyd.

The Chief of the General Staff, in a communication of yesterday, informs me as follows:—

“The Secretary-at-War, in a Dispatch dated 26th instant, tells me as follows:—

“His Excellency the Liberator-President has been pleased to commission the Captains of Engineers, Maurice Falmarc, temporarily commanding the corps in the Isthmus, and John Augustus Lloyd, with the charge of reconnoitring the province of the Isthmus of Darien (a plan of which accompanies this dispatch that your Excellency may let them have it), that they will inform themselves minutely on the facilities, or difficulties, which may present themselves, in this province, in regard to a communication between the two seas.

“If this be practicable, they will make plans of the same, and prepare estimates of the approximate cost of such a work.

“The commission will extend also to their examining the entire province of the Isthmus, where there may be found a point, or points (according to the information of intelligent persons, or guides) where a road, or canal might be opened, or cut, making corresponding plans and estimates.

“The Intendant and Commandant-General of the department will effectively assist the Commissioners, and will inform the Government if these officers diligently devote themselves, or not, to the accomplishment of their commission, and continue efficient.

“The first in the commission shall be Captain Falmarc, the second Captain Lloyd; and they are to be assisted with baggage, animals, vessels, guides, and workmen, and everything else that may be necessary; and his Excellency desires that you will charge these officers, that the Government hope, that in the commission which has been entrusted to them, they will proceed with independence, and not permit themselves to be influenced by local interests, being certain that they will be held for ever responsible to the Government, who forbids them stating anything that they have not seen and inspected with their own eyes.”

I communicate this to you, in order that you may do the same to Captain Lloyd, who is now in this capital, that he may march immediately to fulfil his mission, informing him, that the plan accompanying this order, goes by this date to the Estado Mayor at the Isthmus, that it may be handed to Captain Falmarc.

All this I inform you of, that you may carry it into effect, and present yourself immediately for your passport.

God keep you.

(Signed)

RAMON GUERRA,

Chief of the Staff and Secretary of State.

Lieut.-Colonel LLOYD said, the Paper which had been read was written at the Mauritius, and as he had not then had the advantage of reading Mr. Glynn's excellent Paper,* relative to the same locality, any omissions must be pardoned.

His attention had been directed also to Don José de Garay's excellent pamphlet relative to Tehuantepec;† he did not agree with many of the points there brought forward, but would not then stop to discuss them.

From having been allowed to read the secret archives at Carthagena, he was aware, that a number of observations were made under the Spanish viceroys; but they so feared any knowledge of the Isthmus of Darien being communicated to strangers, that they seized and imprisoned every person who made any inquiries on the subject. Colonel Lloyd had recently heard from M. von Humboldt, that he had never been in the locality relative to which his name was used as an authority, and it was evidently pleasing to that enterprising man, to hear, that his speculative "idea" of the physical nature of the country had been confirmed by actual observers.

General Bolivar had very reluctantly granted the permission to survey the Isthmus, which Colonel Lloyd had solicited, and from this survey he could safely deny the statement, that there were no good harbours, and that provisions were not abundant. He thought M. Garella was wrong in proposing a ship canal, of seven miles in length, from Gatun, as the deepest part of the river Chagres was below Gatun; that river was generally from 28 feet to 36 feet in depth, up to the junction of the Trinidad, without either sandbanks, or rocks; and up to within two miles and a half of the great bay and harbour of Limon, there was water enough to float a line-of-battle ship. His object in proposing a railway across the Isthmus, to start from the Trinidad, was only to open the country, before commencing other works; and he had no doubt, that the Trinidad could be extended and deepened, until it formed a junction with the Rio Grande.

Although at present in comparative comfort, having been in the Queen's service for many years, and although he had only lately applied to be removed out of the tropics, he would willingly

* *Vide* Minutes of Proceedings, Inst. C. E., vol. vi. for 1847, p. 399.

† *Vide* "An Account of the Isthmus of Tehuantepec, in the Republic of Mexico, with proposals for establishing a communication between the Atlantic and Pacific Oceans, based upon the surveys and reports of a scientific Commission, appointed by the projector Don José de Garay." Tract, 8vo, London, 1846.

leave all to be allowed to brave the dangers of the Isthmus, in the hope of seeing the canal cut, as he was sure that in a few years it must be accomplished.

Mr. O'GORMAN said, it had not been his object, in translating the Report relative to the Isthmus of Tehuantepec, to detract from the merits of the proposition of any other engineer. He believed the only practically useful scheme, and that which would be most beneficial to commerce generally, was a ship canal, which should traverse the Isthmus from sea to sea; and he agreed that a railway would be of little use in that country, because of the difficulty of keeping any road in perfect repair during the rainy season, which usually lasted for five months, and then more rain fell in one week, than in three, or four months in England; on this account, a railway would be continually subject to serious damage, by the embankments being undermined, or being wholly washed away, and by the débris from the hills covering up those portions of the line that were in a valley. A railway would also require to be guarded at every five hundred yards, to prevent the iron being stolen by the Indians. Again, the steamers conveying the mails and passengers, would only arrive at intervals of three, or four weeks, and for these alone would the railway be of any use; but the persons engaged for its protection would always require to be on duty.

The passage from Panamá would, he thought, involve an inconvenient and expensive trans-shipment and re-shipment of the goods into boats, at Chagres, or in the bay of Limon; and this would have to be twice repeated on their being transferred from the railway, to the vessels in the Panamá roads. Extensive and substantial warehouses would also be required for the care of the goods, in case of the arrival of vessels with cargoes, on one side of the Isthmus, without vessels being ready to receive them on the other side. That, he conceived, would cause great difficulty and expense to merchants, besides involving the liability to damage from a worm called in that country the "*come gente*," and which acted as a borer, like the "*teredo*," penetrating through a bale of goods in a week.

Colonel Lloyd had not stated the summit level which his proposed ship canal would traverse, or how it would be supplied with water. M. Garella, a French engineer, who was sent out to the Isthmus in 1844, said that the lowest summit level, on the line he should recommend, was 140 metres, or 460 feet, above the sea at Panamá, at the same time stating, that he could not convey water to a higher level than 41 metres, or 135 feet, and then only

by open trenches 165 feet deep, and 61 miles long. He therefore proposed to make, at the height of 131 feet above the sea level, either an open cutting, or a tunnel, much preferring the latter, the length of which should be 5,900 yards, and the height sufficient to allow a vessel of 1,200 tons burthen to traverse it, with her lower masts standing. M. Garella further stated, that the rocks were of so hard a nature, that such a tunnel could be cut with perpendicular sides, though he gave no estimate of the cost, if it should turn out otherwise, nor did he provide for its ventilation, or for shafts to accelerate the excavation. He had estimated that this work could be done for 12 francs, or 10 shillings, per cubic metre, and that the whole cost would be about £5,560,000 sterling; but Mr. O'Gorman thought such a tunnel, with its deep conduits for the supply of water, could not be executed for ten times the estimated sum, and would probably occupy one hundred years in its construction; for if the rock were of the nature stated by M. Garella, the excavation for the tunnel would not advance at the rate of more than a yard per week.

Mr. O'Gorman was, however, very happy to concur in the opinions expressed by Colonel Lloyd, of its being of the greatest importance to the whole civilized world, that a ship canal should be made, at some one, or other of the points alluded to, as offering a possibility for its accomplishment.

Lieut.-Colonel LLOYD agreed, that there were great difficulties to be encountered, for he had been as long as five, or six days going up the river, in a canoe, from Chagres to Cruces, during heavy rains. He had also seen in the warehouses, ranges of goods eaten completely through by the "come gentes" in two days.

As Mr. O'Gorman had acknowledged, that he did not place confidence in M. Garella's estimate of the cost of driving a tunnel, Colonel Lloyd took the same liberty of doubting his measurement of the summit level, which was really only about 606 feet over the highest ground, instead of the lowest level being 640 feet; but he also thought M. Morel's estimate of 12 metres, or 39 feet 6 inches, was under the mark. The levels taken by himself and Falmarc, and which were recorded in the *Philosophical Transactions*,* were more for the purpose of ascertaining the difference of height between the Atlantic and Pacific Oceans, than for anything else; but, subsequently, he had followed the courses of the rivers, and was convinced, from the nature of their banks, that there was no high summit level to be surmounted.

* *Vide Phil. Trans., 1830, page 60, et seq.*

He must contend, that it was improbable there would be any deficiency of water. From the notorious fact of there being rain during full nine months of the year, and high lands and conical hills in the immediate vicinity, above the line of the intended canal, no reasonable doubt could be entertained, of there being an ample supply of water for the lockage.

It might be as well to state, that for a canal communication, the following would be something like the respective lengths of the various routes that had been proposed :—

By the Nicaragua route	. . .	350 miles.
„ Tehuantepec „	. . .	150 „
„ Panamá „	. . .	31 „

Mr. GLYNN said, he had listened with great pleasure and satisfaction to the observations made by Colonel Lloyd. When he laid before the Institution, three years ago, a Paper on the subject,* he was induced to take up the question, by finding, in Paris, that the French engineers were devoting much attention to the subject, and had been making use of Colonel Lloyd's surveys ; and it was to be regretted, that the valuable stores of information which Colonel Lloyd had collected, and which were to be found in the archives of the Geographical Society, were used by foreigners, but neglected by Englishmen. When preparing that Paper, he was told, that the construction of such a work, as a canal between the two seas, was an exploded fallacy ; but he was convinced, that the more the subject was investigated, the sooner would all difficulties vanish.

He thought M. Garella's estimate of the summit level was too high, and that if he had explored the country to the west, he would have found a much better line, than that laid down by him. M. von Humboldt had also described the route from Panamá as being almost impracticable ; but if he had gone more to the west, as Colonel Lloyd had done, he would have found the country to be of a different character. Those who had crossed the country between the fork of the Trinidad and the Chagres, generally agreed that there was a large tract of low ground in that direction.

The account of the geological formation of the country showed there would be little difficulty to contend with, in the construction of the canal ; the greatest would be on the side nearest to Panamá, where the hills consisted of detached masses of stone, embedded in clay. It would appear, from the evidence, that there was a great probability of a passage having existed at one time, and that by some convulsion of nature it had been interrupted, on the side next

* *Vide Minutes of Proceedings Inst. C. E. vol. vi., for 1847, p. 399.*

to the Pacific. Altogether, he thought the difficulties of the work would be more of a political nature than in engineering details.

Mr. EVAN HOPKINS said, he would briefly state the result of his investigations during the years 1847 and 1848, when he was officially employed by the Government of New Granada, to survey and explore the Isthmus, from the Darien to Veraguas. He exhibited several charts and maps of different portions of the Isthmus, and sections taken across it in various directions, from which Plates 4 and 5 had been compiled.

The chain of the Andes did not continue through the Isthmus of Panamá to North America, as was generally supposed and was shown in maps, but there were many breaks in the range towards its extremity. The Andes were divided, a few degrees north of the equator, into three great branches, which terminated on the shores of the Caribbean Sea; these he had crossed several times, when he made a geological section of them, and had measured their respective heights by the barometer. Besides the Andes Proper, there was a western limb, forming the Choco branch, which terminated at the gulf of San Blas, and was separated from the main chain, by the valleys of the Atrato and San Juan. The sources of these rivers were within a short distance of each other, and the country between them was comparatively so low, that he had known persons who had come up the Atrato in canoes, drag them over it, and then descend the river San Juan to the Pacific. The Choco chain had also numerous breaks, by which the natives were able to walk across, from the tributaries of the Atrato, to the Pacific; all these passes, however, were only of local benefit, and were not applicable for the purposes of a great commercial communication between the two seas.

The Isthmus of Panamá was totally distinct, both geologically and topographically, from the great chain of the Andes. It was a narrow neck of land, but thinly covered with red ferruginous soil, so that it was somewhat barren, and subject to be scorched in dry seasons. It was extremely irregular in its configuration and surface outline, forming a series of oblong ridges and conical hills, but very uniform in the cleavage planes of its primary, or crystalline base, which ran north and south, transversely to the Isthmus, and were parallel to the great meridian structures of the South and North Americas. The Pacific coast had risen about 20 feet, within a comparatively recent geological period, and had evidently been exposed to higher tides, as many beds of recent shells were found on the inland flats. The north coast only appeared to have risen a few feet, from Chagres to San Blas.

The Isthmus was composed principally of primary crystalline rocks, such as porphyries, granites, hornblende, and a variety of schist, with a few isolated caps of argillaceous and arenaceous sedimentary beds, more or less denuded into cones and oblong hills, and broken by a series of ravines, much depressed between Panamá and Chagres. Where the hornblendic granite passed into porphyry, sienite, greenstones, and other hard slaty rocks, the surface of the mountains presented steep rugged edges, and rose abruptly, like walls, passing alike both mountains and valleys. The hornblendic felspar, which constituted one of the principal ingredients of the crystalline rocks of the Isthmus, predominated in iron and potash: this would account for the deficiency of lime in the series, and indeed calcareous felspar was seldom detected.*

The granites exfoliated, and were decomposed into globular masses, the concentric subdivision of which produced titaniferous crystals, with gold, but that metal was only developed, during the change from the crystalline to the globular structure; the disintegration of the granite was, however, sufficient to produce the gold-washing deposits, at the foot of mountains.

There were no volcanic rocks in the Isthmus of Panamá, or at least none showing any indication of having been melted by fire, or like the dry glossy lava of igneous volcanoes; they were all more or less crystalline, having a large proportion of water chemically combined with them. The island of Taboga, in the Pacific, appeared, however, to have been lifted by an igneous intrusion of ferruginous rocks, and was the only indication of volcanic action near to Panamá; on it there were good springs of pure water, and corals growing, serving as food for marine animals.

There were two interesting points, and, according to his surveys, the only practical ones, for making a communication between the Atlantic and Pacific Oceans. One of these was in the Isthmus of San Blas, and the other was between Chagres and Panamá.

Mr. Hopkins had made the first survey of the river Bayano, accompanied by Mr. Hurtado, a native engineer, with a number of men, instruments, &c., under his charge, and was instructed by the Government to continue the survey to the gulf of San Blas, and the coast of the Darien. The Indians who were in possession of that country looked with jealousy on all who approached their territories; and although he was able to explore the river Bayano,

* The porphyritic rocks of the Andes, near Choco, effervesced with acids, like limestone, in consequence of the calcareous character of the felspar.

to the extent shown on his map (Plate 5), and to make his triangulation to the peaks of the intervening ridge, the Indians prepared to resist his passing over to the coast of San Blas. He had found the river Bayano navigable for vessels of 12 feet draught, to the bend at the foot of the ridge (to which point the tide rose), which was distant about five leagues from the excellent bay of San Blas, on the north coast. The Bayano was a fine, wide, but tortuous river, larger than the Thames, with very fertile banks; in fact, it traversed the most productive ground in the Isthmus of Panamá.

He then pointed out the route from Panamá to Portobelo, following the old Spanish track, and gave a general view of the difficulties attending it, with an account of his survey both geologically and topographically. From having crossed it on foot, in three or four different places, he was enabled to say, that it was impossible to make a road, or indeed anything beyond an ordinary track, in that direction, as the ground was very high and broken.

After thoroughly exploring the ground between Portobelo and Panamá, with so little success, he proceeded to examine that between Chagres and Panamá; and the result of his investigations, in this direction, showed, that the valley of the Chagres, as far as Gorgona, in connexion with the valley of the Rio Grande, was the most eligible for a communication, whether by a common road, a railway, or a water communication. According to Colonel Lloyd's levelling, the river Chagres, at Gorgona, was about 35 feet above the level of the Atlantic; the highest ground of the village was about 60 feet higher, and the height of the ridge above the plains of Gorgona was from 150 feet to 160 feet; so that the highest point, on the line of lowest depression, between Gorgona and the head of the Rio Grande, was only about 260 feet above the mean level of the Atlantic, and that was composed, principally, of ferruginous hornblendic rock of a friable nature. After making this survey, he had reported to the Government, that a good road, or a railway, might be easily made along this route to Panamá, and was preferable to making a road to Cruces; but that he considered, that a combination of the two would best serve the purpose. The line shown on his map (Plate 5) followed the banks of the Rio Grande from Panamá, it then crossed the ridge to Gorgona, and passed along the banks of the Chagres for some distance down the river. Another sketch showed the continuation of the railway to the coast, and also to Portobelo, which had an excellent port; and on this account the Government were very anxious that it should be rendered available, more especially as Chagres had no port, and the Bay of Limon was very open and shallow. This object

could be effected, by means of the valley of the Chagres and the coast, but the distance would be increased to about sixty miles, or the same as the track by the Boqueron.

The tide of the Caribbean Sea, at Portobelo, was only from 1 foot 6 inches to 2 feet, whereas it varied from 16 feet to 24 feet in the bay of Panamá. This difference had given rise to the general impression, that the Pacific was higher than the Atlantic;* but the fact was, that the tide of the Pacific was produced by large transversal periodical waves propagated from the south, like those of the Red Sea, and, by coming in contact with the Isthmus, caused the sea on the south side to be sometimes higher, and at other times lower, than the sea on the north side. Now, Mr. Hopkins thought, that if a water communication was once effected, the channel would soon be deepened, by the aid of the oscillating action of the Pacific tides, assisted by dredging and other artificial means.

The present roads between Panamá and Gorgona, and between Panamá and Cruces, were extremely bad; the former being the worst of the two. This was explained by the fact, that the natives always preferred following the ridges, as they were dry, and they avoided the low level ground, which was intersected with deep ditches and covered with mud, although that was the direction best adapted for making a useful common road.

The materials of this portion of the Isthmus were not of a superior character. The timber consisted of a variety of cedars, and other soft woods, with a few harder varieties, such as guyacum, or *lignum vitæ*, &c.; but there were scarcely any that combined strength with lightness, so that pine and other varieties of timber would require to be brought from the United States. The trees in South America must be cut during the decline of the moon, or the timber would be subject to dry rot, and would become useless in a few months: this was the case from the Brazils to North America. There was no limestone, either primary, or sedimentary. The lime used was entirely procured from the calcination of marine shells and corals, the latter of which grew most luxuriantly on the coast

* "The mean level of the Pacific is about three feet higher than the Caribbean Sea; it is high water, full and change, at 3h. 20m., and the night tides are greater than the day. The tides are great waves propagated from the south in the Pacific, Atlantic, and the Indian seas; but in the Baltic and other inland seas there are no tides. The tides generally rise higher on the south side of an isthmus, than on the north; thus, on the shores of part of Nova Scotia the tide rises 75 feet on the south side, but only about 6 feet on the north; again, the Red Sea has tides of 30 feet, whereas in the Mediterranean the alteration of level is scarcely perceptible."—*Extract from a Letter from Mr. E. Hopkins, to the Secretary Inst. C.E.*

of both seas. Portobelo was entirely built with coral rocks, and Panamá with the sandstone of that coast. The predominating rocks were compounds of silicates of alumina, potash, magnesia, and iron. The building stones of Panamá were scarce and very inferior, requiring great care in their selection; but good stones might be procured from other quarters bordering on the coast.

During Mr. Hopkins' surveys, his assistant, Mr. Hurtado, superintended the erection of a fire-proof building, at Cruces, near the centre of the Isthmus, for the bullion belonging to the West India Steam Packet Company. Very good stones were obtained for the purpose in the neighbourhood, but all the lime was obtained from the corals and shells of the coast. Mr. Hurtado had also superintended the erection of several bridges and culverts for the roads in the interior, as well as the repairs of the fortifications of Panamá; the lime for all these works had been brought from the islands of the Pacific, as there was none to be found in the interior of the country.

Mr. Hopkins considered the natives of the Isthmus to be the worst set of people, of all the Grenadinos, for manual labour; indeed he had reported to the Government, that in the event of any great work being undertaken, men of more industrious and active habits would be required; nor could the country be considered favourable for agriculture, for though it was true that there were fertile lands on the banks of the principal rivers, they were not of sufficient extent, or importance, to offer any inducement to emigrants. This was fully proved by the fact, that if the Indians of the Darien and Penonome, and the islands of the Pacific, did not supply the inhabitants of the Isthmus of Panamá with food, they would scarcely be able to exist.

The passage of the Isthmus was a most interesting question, and although in the absence of those accurate surveys, upon which similar works were commenced in Europe, there must be some difference of opinion as to the most practicable line for a communication between the two seas, he thought it would be generally admitted, that there were no insuperable difficulties, arising either from the climate, the population, the character of the country, the materials, or the extent of the work, which should suffice to prevent the accomplishment of an undertaking of such vast commercial importance to the whole world.

Lieut.-Colonel LLOYD had not anticipated meeting so powerful an auxiliary for the main object of his communication, or so formidable an opponent in some of his statements and opinions, as Mr. Hopkins appeared to be; however, he thought, that between them, the real facts of the case would be laid before the Institution.

He had travelled over every part of the Isthmus of Panamá, and could therefore corroborate the statements of Mr. Hopkins with respect to it. The Portobelo track could not be made available, except by great expenditure, and encountering immense natural difficulties; indeed the name given to one of the mountain passes—"lo que come paga" (he who eats must pay) sufficiently denoted its local reputation.

He differed altogether from Mr. Hopkins, as to the materials for works; there existed abundance of the finest limestone, and an immense variety of timber, in almost interminable forests. He had brought home a large collection of specimens of the rocks and minerals, and of the timber of the Isthmus, and had deposited them respectively at the British Museum and at the Admiralty, where they could be now inspected; and in the Transactions of the Geographical Society for 1831,* he had given a description of the river Chagres for a hundred miles from its mouth, including the wonderful scenery of "La Bruja," a mountain which, he believed, had not been ascended by any European except himself, and the picturesque range of hills which had all the characteristic forms of limestone. He must differ with Mr. Hopkins, as to the question of materials, whilst he thanked him sincerely, for the powerful assistance his statements had given to the general question.

Mr. R. STEPHENSON, M.P., *V.P.*, regretted he could not afford much information on the subject, as although he was well acquainted with Carthagena and its neighbourhood, he had never been on the Isthmus. As to materials, he could answer for there being plenty of lime at Carthagena and in the surrounding district, where it was procured by calcining the coral rock, which extended, in one direction alone, for upwards of sixty miles.

He had examined all the reports relative to the Isthmus, and he saw nothing to deter enterprising men from undertaking the cutting of a ship canal; but he thought that the converse of the usual system must be followed, and that a simple and inexpensive railway, like those in the United States, must be first made, and by its aid, the canal might be commenced at several points simultaneously; and although the works might be heavier than usual, he was of opinion the canal would not be found difficult of accomplishment.

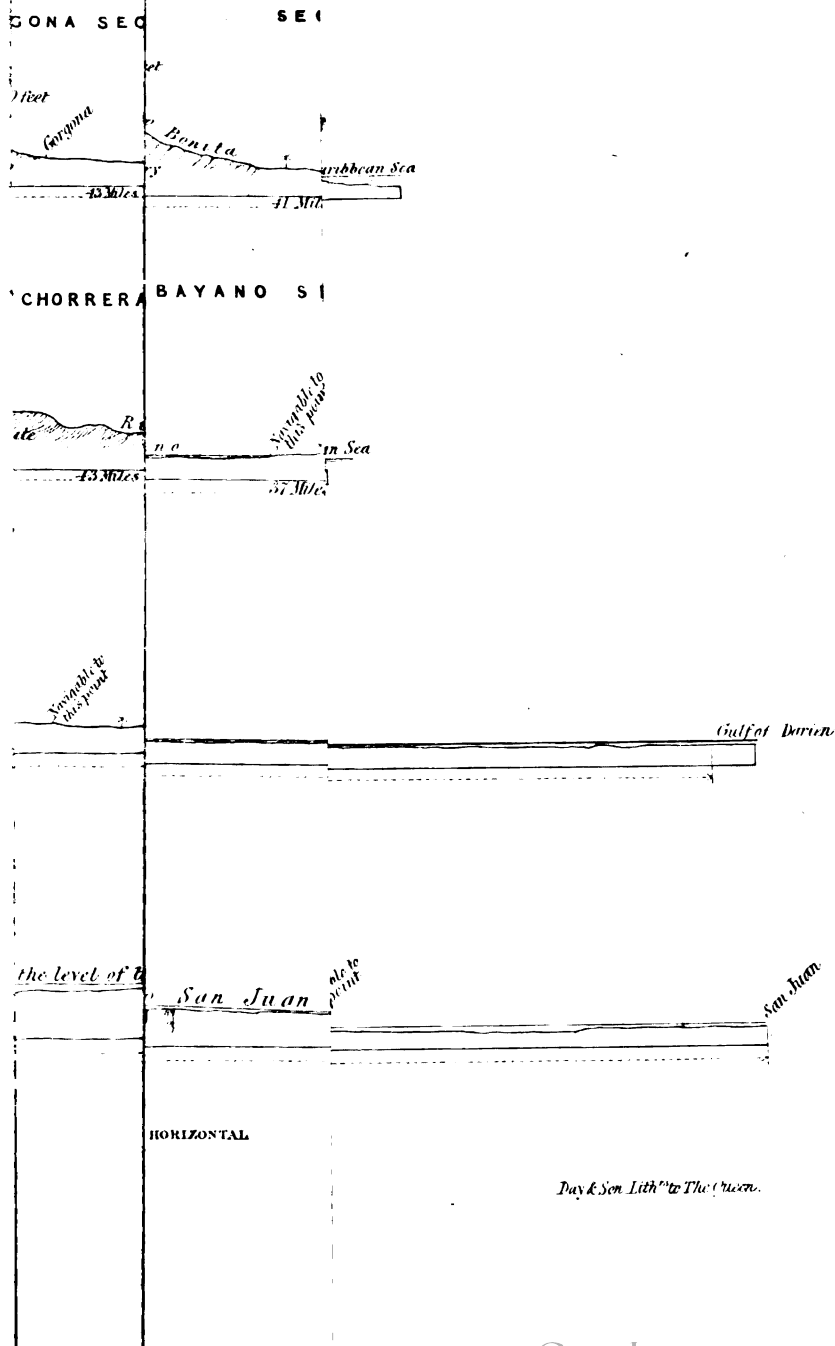
He believed that the route by the river Chagres, as far as Gorgona, thence across the country to the Rio Grande, and by that river to Panamá, would, most probably, be adopted, as it offered generally better facilities.

* *Vide Trans. Geograph. Society*, vol. i., p. 69.

Lieut.-Colonel LLOYD stated, in answer to a question from Captain Moorsom, that he believed the gold-washers in the Atrato district did, in very wet seasons, make a passage from sea to sea, in their canoes; but it was by a most tortuous course, of nearly three hundred miles in length, and was perfectly impracticable for all purposes of commerce.

Mr. GLYNN said, it appeared to him, from the numerous books, papers, and reports which he had examined on the subject, that most of the persons who had traversed the Isthmus, had been compelled to take either the beaten road, or to follow the river Chagres; it was clear, however, to him, that there was a large level tract of unexplored country, situated to the west and southwest of the river Chagres, of an extremely woody and marshy nature, and traversed by the river Trinidad, which was navigable for some distance, for ships of heavy tonnage. The marshes of Agua Clara, and the presumed locality of the lake of Vino Tinto, indicated also the level character of the country. Colonel Lloyd had proposed to make one of his lines of railway nearly in that direction, but had not been able to survey it, on account of the thick forest, the immense size of the trees in which proved, that there was a great depth of soil fit for vegetation. Mr. Glynn, therefore, thought they must suspend their judgment, as to the practicability of a canal, and the eligibility and expense of any particular route, until there was more accurate information on the capabilities of the Trinidad, and the other rivers in that district. There was, at least, evidence to show, whatever might be the precise result of further information, that the best routes had not yet been examined, and that the Chagres did not present such facilities, as might be obtained by the route between the rivers Trinidad and Chorrera. Both of these rivers, although running to the opposite coasts, had their sources in one hill, the Cerro Trinidad; and it was evident, that the districts, through which they passed, were of a comparatively level character, with a few isolated hills of small elevation, situated at some distance from each other.

Mr. HOPKINS said, in reply to the observations of Mr. Glynn, that, during a lengthened residence in the country, he had examined the district alluded to, and, in short, he was prepared to enter into the question of the physical character of the whole country, from Choco to Central America, and of the Isthmus of Tehuantepec, in sufficient detail to be enabled to discuss the relative merits of the various schemes, for forming a communication between the two seas. He found the heights of the different mountains, between the Trinidad and Chorrera, to be from 300 feet to 800 feet. The



Day & Son Lith'rs The Gracere.

charts exhibited would give any further information that might be required on the subject.

Mr. R. STEPHENSON, M.P., *V.P.*, observed, that on returning from the Darien, in 1828, he met Mr. Trevithick, at Carthagena, and had been informed by him, that he had traversed the Isthmus three times, both in the direction mentioned by Mr. Glynn, and in others; from this inspection Mr. Trevithick concluded, that the route by the river Chagres and the Rio Grande was the most feasible one, and that which ought to be adopted.

Mr. T. M. SMITH handed to the Secretary the following extract, from a communication received from Commander Maclean, and as it related to the Isthmus of Panamá, it was, with the permission of the President, read to the Meeting:—

“Subsequent to 1817, I made many visits to the Atlantic coast, and harbours of the Isthmus; among them the River San Juan Nicaragua, which, in my opinion, is the place best suited for the communication between the two oceans, by canal, for steam navigation, or such vessels drawing about 15 feet water; I do not think the river could be made available for a greater draught, or any artificial entrance, on account of the shifting sand on the coast, which becomes tenacious at all inlets within its range, that are above, or about the level of 15 feet; it would be impracticable to deviate those sands from their natural channel. The great waters of the Lake Nicaragua,* make this a most

* The following extract of a letter from the Hon. E. G. Squier, was read by Mr. J. R. Bartlett, at a meeting of the American Ethnological Society, 1st December, 1849:—

“*Leon de Nicaragua*, 10th October, 1849.

“My time has been much occupied with public business, nevertheless I have been able, during the intervals of my negotiations, to give some attention to science. One discovery, in particular, I must make known to you, as it is one of very great interest.

“A short distance back from the city of Santiago de Nicaragua is the crater of an extinct volcano, filled with water. It is surrounded by bare cliffs, some 3000 or 4000 feet high, in all places perpendicular, and having but one narrow, precarious descent to the water. Upon these cliffs, at the height of 50, or even 75 feet, are paintings of the aborigines, precisely in the style and of the character of those found in the ancient Mexican and Guatemalan MSS. They more closely resemble those of the MS. of the Royal Library of Dresden than any other, which manuscript, I am convinced, was of Guatemalan origin. In fact, some of the figures are identical, and amongst them stands out the symmetrical feathered serpent! I enclose you a sketch of this figure, roughly traced with a pencil, from my drawing.* This is a valuable fact in my serpent phi-

* The wood-cut was kindly furnished by Mr. Jerdan.

“eligible site for the canal, but it would not answer for such
 “vessels as are used in trading to Australia, China, and India; it
 “would, however, be very desirable to have a communication, by
 “canal, to the ports of the Pacific. By this route there are four,
 “or five rapids (which will require to be avoided by cuts), before
 “reaching the Lake Nicaragua, which is 16 leagues long, 35
 “leagues in circumference, and 12 leagues to 15 leagues in width.
 “The soundings in the lake are from 5 fathoms to 6 fathoms
 “water. From the entrance of the River San Juan to the lake is
 “about 72 miles.

“Length of the Lake . . . 48 , ,

“Thence to the Pacific . . . 30 , ,

150 miles.

“The route between Chagres and Panamá, is better adapted for
 “the projection of a railway, than a canal.

“I proceeded up the River Chagres to the village of Cruces,
 “about 25 miles, thence by very mountainous land to Panamá,

losophy. There was originally a large number of paintings, representing
 dances, processions, &c.; but unfortunately the wall of rock upon which they
 were painted was thrown down only four years ago by an earthquake. The



fragments alone remain to increase the regret the antiquary feels that there
 was not earlier some hand to secure these fading memorials of the aboriginals
 from destruction. Many of the paintings were so much defaced as to baffle all
 attempts to make them out. I have all that are distinct. The lake bears the
 poetical name of *Nehapa*. I have heard of other similar paintings about 30
 miles from these, which I intend to visit, and of which you shall hear anon.”

“ about 20 miles; the direct distance is not more than 30 miles;
“ but the windings of the river and the then pathway cause the
“ difference. The River Chagres, at the entrance, has about
“ 15 feet, but there is generally a very heavy surf on the bar,
“ which is dangerous to vessels; those drawing 12 feet water can
“ only cross it at the most favorable time. To avoid this it would
“ be desirable to have a canal from the bay of Limon, or Navy
“ Bay (where our men-of-war and steamers anchor), five miles east
“ of Chagres; it is open to the north wind, but a breakwater might
“ be formed across it, to seaward of the coral rock, which abounds
“ there. The good anchorage in the bay is in about 5 fathoms
“ water; the distance by the proposed canal to the River Chagres,
“ is $2\frac{1}{2}$ miles: the ground being level, no locks would be required.

“ The railway is proposed to commence from the Trinidad
“ rivulet, about 10 miles up the Chagres river.

“ I had no opportunity of observing the difference of level
“ between the two seas, and only form my judgment, that the
“ Pacific is higher than the Atlantic, from the great currents run-
“ ning out of the rivers; also the rise and fall of the tide at
“ Chagres is only about 1 foot, while that at Panamá is about
“ 18 feet, or 20 feet.

“ Much difficulty must be encountered, in constructing a canal
“ of communication between the two oceans; the climate is most
“ unhealthy (until you reach the Pacific) for Europeans to live in,
“ and even animals, with the exceptions of pigs and mules, waste
“ away and shortly die.

“ There was a line contemplated, between the River Gerasacalo
“ (on the coast of Tabasco, Gulf of Mexico, on the way to Vera
“ Cruz) to the river and bay of Tehuantepec, in the Pacific. I
“ visited the first-named river in 1825, for the purpose of shipping
“ some bales of cochineal, which I was informed by the shipper,
“ had been brought from the Pacific by water, in canoes, down
“ different rivers, a distance of about 200 miles; when they arrived
“ at any rapids, the canoes were unloaded, drawn over to the
“ smooth water, and then reloaded. On the bar of the river there
“ is 15 feet water, but immediately across it, from 8 fathoms to 10
“ fathoms.

“ In the American President's address, he alludes to the various
“ schemes for communication between the two oceans; he proposes
“ it should be done by private enterprise, conducted by united
“ nations, and protected by their Governments. Treaties to be
“ made for the purpose with the Government of Nicaragua: this
“ will prevent monopoly. All nations who join in the treaty to

"make use of the navigation, paying a fixed toll which they jointly agree to."

Lieut.-Colonel LLOYD said, it would be absolute insanity to commence any large works, without an assurance of the existence of an ample supply of materials of all kinds, but more especially of lime and timber, which, he must still contend, were to be found in large quantities. In corroboration of his own observations, he might quote those of Captain Foster, who, in giving an account of his labours in H.M.S. "Chanticleer" in 1829, stated, that in ascending the rivers, the boats passed between cliffs of the finest limestone, and through immense forests of timber of infinite variety, some of the wood being so hard, that the axes were unable to cut it.

Whilst in the Isthmus, Colonel Lloyd made a considerable collection of specimens of the minerals and woods of the country; the former had been classified by Mr. König, of the British Museum, and from the list which he presented,* it would be perceived, that

* List of specimens of minerals brought from the Isthmus of Panamá, by Lieut.-Colonel Lloyd, and classified by Mr. König.

No.	DESCRIPTION.	LOCALITY.
109	{ Part of a nodule of quartz, passing into chalcedony, } { the latter crystallized on the surface }	Hacienda de Los Caceres.
145	A curious flint in layers	Pt. Paitilla.
155	Chalcedony	Algarobo.
110	{ Part of a nodule of bluish-grey chalcedony in con- } { centric stripes. }	Rio Algarobo.
130	A fragment of decomposing chalcedony	Rio de las Lajas.
138	{ Part of an agate nodule, lined with crystals of ame- } { thystine quartz }	Rio Cascajal.
209	{ Chalcedony covered with chlorite, with crystals of } { Carb. of Lime }	Near Rio de la Puente.
134	Chalcedony, partly coloured green heliotrope	Near Algarobo.
137	{ A turbinated flint in layers, decomposing into cacho- } { long }	Panamá and Cangrijo.
120	{ Ochry red iron flint, with quartz and disseminated } { iron pyrites }	Bed of ravine near Gorgona.
136	Brown and yellow jasper agate	Rio Chagres.
125	{ Part of a decomposed grey hornstone boulder, with } { tuberculated surface }	Cruces and Gorgona.

the rocks were of igneous origin, and consisted of porphyritic trap, nodules of quartz, heliotropes, agates, and jaspers, flints, chalcedony, chert, &c., and in the collection brought by him from that country, there were five different descriptions of limestone, viz., compact limestone, shell limestone, calcareous grit, and decomposing limestone. From personal examination, he could assert, that in the Isthmus of Panamá, in the vicinity of the line he had proposed, there was not to be found a particle of granite, porphyry, or gneiss, nor any hard sedimentary rock; and he especially referred to his note, on the nature of the country, its resources in timber, and plentiful provisions, and the statistics which he had published in the *Transactions of the Royal Geographical Society for 1831*.*

He had brought over one hundred and twenty-six specimens of timber, and had deposited them in the collection of the Geographical Society and the Admiralty, and he thought it would be difficult to

List of Specimens of Minerals—*continued*.

No.	DESCRIPTION.	LOCALITY.
143	Splintery hornstone	Rio Cascajal.
157	Hornstone, or aphanite, in huge blocks	Lucho Franco.
173	Burnt chert	Rio Chagres.
115	Aluminous indurated clay	Beach, at Panamá.
127	Bluish black basalt	Rio Boqueron.
128	Bluish grey fetid COMPACT LIMESTONE	Cerro Almùante.
133	{ Brownish SHELL LIMESTONE, composed chiefly of particles of bivalves and grains of compact lime- stone }	Rio San Juan and Cruces.
152	COMPACT LIMESTONE, with reddish veins	Rio de la Puente and Rio Chagres.
154	{ CALCAREOUS GRIT, composed chiefly of conglomerated sand and fragments of shells }	Below Cruces.
163	DECOMPOSING LIMESTONE	Near Rio de la Puente.
164	{ Specimen of very heavy and compact coral, surround- ing the great Bay of Limon. On pieces being detached from the great masses, and thrown on the shore below low water, the animals imme- diately build and firmly fix the rock to the sand . }	

* *Vide Trans. Geograph. Society, vol. i, p. 69.*

produce finer specimens for any purpose. Some sticks were found so straight, as to be perfect prizes for masts; and Carthagena was supplied with gun-carriages from the Isthmus. There was a regular trade in building timber from Panamá to Peru; a saw-mill was established at Pacora, which had cut from twenty to thirty thousand planks per annum; but timber was too cheap and common, throughout the country, to allow any profit to be realized. On the other side of the Isthmus, all descriptions of dye-woods were common, and were to be seen lying on the beach for exportation. A large quantity of the *Cocobolo prieto*, or bastard rosewood, had been sold for a good price in England.

He disagreed with Mr. Glynn, as to that portion of the country, which he supposed had not been explored; it had, perhaps, not been critically examined, but he thought no more time should be consumed in further researches. The time was now arrived for carrying out the work of traversing it by some means, and he knew of no nation so well adapted, from its vast wealth, its talent, and above all its honesty, to undertake and carry it on as the English; if they did not do it soon, somebody else would accomplish it; and considering that it would be the great highway of the world, he was most anxious it should emanate from, and be maintained by, Great Britain.

Captain Moorsom said, that knowing the high land to the southward of the route mentioned, did not exceed 300 feet, or 400 feet in height, that the depressions were constantly below that level, and that the summit levels spoken of, were anything but decisively ascertained, it appeared to him, that stage of the proceedings had not yet been attained, in which any particular route could be decidedly adopted. He considered this to be a matter of the greatest importance, as any error of that kind might involve an unnecessary expenditure of some millions. Therefore, while he agreed with Colonel Lloyd, that they should be as energetic as possible, he still thought, before anything was hastily done, they should have an accurate knowledge of all the routes, and among others the one to the southward, which had not yet been described. The hills to the south of the embouchure of San Miguel, were quite as low as those in the north, and on one particular route, the summit level, as shown by trigonometrical measurements, taken in 1849, did not exceed between 250 feet and 300 feet. There was also the remarkable fact, that within five miles of the shores of the Pacific, the river Napipi, running from south-west to north-east, joined the Atrato, which flowed, from north to south, into the Atlantic. It therefore appeared to him, that a passage might be found to the south, with a summit

level of 250 feet, or thereabouts, with an abundant supply of water for a ship canal, which might discharge itself at a distance of only five miles from the Pacific. The route alluded to, was not strictly from the bay of Cupica to the Napipi, but from a small bay to the south of Cupica. The river Cupica led into the hills, but the pass in question, after crossing the summit, led to the Napipi, flowing through an extensive plain of gravel and alluvial soil.

An officer who had been charged with a survey on the Pacific coast, had communicated to him the facts above referred to, and while he appreciated the labours of Colonel Lloyd and Mr. Hopkins, he did not think that either of them had entered, with sufficient accuracy, into those particulars, which were requisite for affording information, as to the best line for a railway, or a canal, or both, in that country; nor could it be considered as sufficiently decisive, and all that could be required, before proceeding with such works, or with the concession for the particular territory, which must be obtained from the local Government.

Lieut.-Colonel LLOYD agreed, that great care was required in the selection of a route, but he was sure nearly all the lines would eventually be adopted. The express object of his journey to Panamá, was to find out the best route for a canal, and the highest point he had taken in his levelling, along the beaten track, was 620 feet; and that was directly over a mountain. By Tehuantepec, the lowest point to be found was from 620 feet to 640 feet. By the track he had proposed difficulties would be encountered for thirty miles. The route by Tehuantepec was one hundred and fifty miles; by Nicaragua, it was three hundred and fifty miles; and the track suggested by Captain Moorsom was at least three hundred miles long, in a tortuous course.

Mr. HOPKINS must reiterate his previously-expressed opinions, relative to the absence of lime, and of good building timber, in any available quantity, in the Isthmus of Panamá; at the same time he wished it to be understood, that he did not state the fact, as an insuperable obstacle to the making of a communication between the two seas, but only to avoid an undue value being given to the productive resources of the country.

A stranger from Europe would at first be struck with forests which appeared interminable, and would naturally conclude, that the supply of timber for every purpose must be inexhaustible; but to one who had conducted large works in that country, such ideas became considerably modified. It was true, that there were great varieties of hard and fancy woods scattered in different parts of the Isthmus, especially near the Darien, Portobelo, and Veraguas; and

along the banks of the Gatun, a good variety of cedars might be found, but within the space in question useful timber for public works was comparatively scarce. Men might be sent into the middle of the forest, who would be months finding good building timber, or even any fit for charcoal. He also knew the exports of the country well: at Panamá there were not any; they got their timber from the Gulf of San Miguel.

The crystals of carbonate of lime, mentioned in Colonel Lloyd's list, were such as might be obtained in the granitic and slaty districts of Cornwall and Wales, accompanying mineral veins, &c.; but this could not warrant the assertion of there being limestone quarries in the Isthmus of Panamá. Indeed the English Consul, participating in the general opinion of there being plenty of limestone, from the representations which had been made, had induced him to make a very careful examination of the country, and the result of his investigations was that he found no limestone, a fact with which the natives were previously well acquainted. The inhabitants were obliged to procure their lime from the calcination of marine shells, and coral rock from the Pacific; and all the rocks which had the appearance of limestone were either white felspar, indurated silicate of alumina, or loose lumps of coral found in the river Chagres.

During his survey of the Isthmus of Panamá, it had been communicated to him, by Captain Kellet, of the "Pandora," who was then engaged making some surveys, that a new communication had been found from the Atrato to the Pacific coast, between Cape Corriente and Cupica, along which the natives had managed to pass, and which was likely to be better than the route by Panamá; but on Captain Kellet sending some of his own men to the spot in question, it was found that the difficulties were much more formidable than he was led to expect, and in fact that it took three or four days to traverse a mountain pass to the Atrato. He therefore considered the communication in that direction was not to be compared with that by Panamá, and he had accordingly recommended the Government to make a substantial road, with a railway alongside, and afterwards to go on with the water communication.

It had been reported, that the Americans were now about to commence a railway on the route proposed by Mr. Hopkins, from Gorgona to Panamá, the contract for which, it was said, had been already let to Captain Totten, who was taking a complete set of labourers from Carthagena, and the United States, to execute the works, and had made arrangements to procure the most useful kind of timber, and other materials, from the States, on

account of their being cheaper and better, than any found in the Isthmus.

Captain Sir EDWARD BELCHER, R.N., said, that in 1836 he was sent out by the Government, to investigate the facts of Colonel Lloyd's report, and he had great pleasure in verifying everything he had stated, relative to the tract between Chagres and Panamá. Limestone was everywhere found, in the rounded shingle in the bed of the river. The rocks became rather disintegrated after reaching Gorgona, and on approaching the bay of Panamá, and even down to the Pearl Island, they were entirely basalt.

One of the objects he had in view, was to measure the meridian distance between the two seas; the exact distance, between Gorgona and Panamá, was thus ascertained to be 22 miles. In doing this, he was compelled to cut away some trees which intercepted the line of sight; this he had found great difficulty in accomplishing on account of their hardness, they being a sort of iron wood. It should be recollected, in considering what timber would be useful in the Isthmus of Panamá, that there was another enemy to guard against, the white ant, which, he thought, none of the timber from America could withstand, and that after being laid down about six weeks, it would be quite useless, if not entirely destroyed. He was not aware that there would be any difficulty in making a railway across the Isthmus, which would afford a convenient means of passing over it in about three hours.
